Picosecond Two photon Laser Induced Fluorescence in Kr

Kristaq Gazeli*[1], Xavier Aubert[1], Swaminathan Prasanna[1], Corinne Y. Duluard[1], Khaled Hassouni[1], and Guillaume Lombardi[1]

[1]LSPM, CNRS, UPR 3407, F-93430 Villetaneuse, France – University Sorbonne Paris Nord – France

Résumé

Recent developments in plasma science and technology have opened new areas of research for fundamental purposes and diverse applications [1-5]. With the increasing availability of ultrafast lasers (ps – fs pulse duration), a better understanding of the physicochemical processes taking place in high-pressure plasmas can be achieved [2,4]. For instance, ps and fs lasers have been useful for the determination of the absolute density of atomic species (such as N, H, O) in non-equilibrium plasmas [2,4,5]. However, the implementation of those diagnostics is not as simple as it would be in the case of ns-TALIF at low pressures [3] where non-saturated regimes can be obtained relatively easy. Indeed, the high energy density of ps/fs lasers may lead to significant depletion of the excited states of interest due to photoionization and/or stimulated emission processes, affecting the recorded TALIF signal. Therefore, suitable operating regimes should be defined to avoid TALIF signal saturation in this case and perform reliable measurements of atomic species absolute densities.

The present study demonstrates the feasibility of the application of ps-TALIF in Kr at variable pressure (0.1 – 10 mbar). For high laser energies (ELaser $>$ 0.6 μJ/pulse), a saturated TALIF signal is obtained along with broader absorption line profiles. For low ELaser ($<$ 0.6 μJ/pulse), the line profile is much narrower and the quadratic dependence of the TALIF signal versus ELaser is revealed, as it was reported recently in [5]. Therefore, Kr can be used as a calibrating species for the evaluation by means of ps-TALIF of the absolute density of N and H in different plasmas. This is of interest for numerous applications (e.g. thin film synthesis [1]), for which the knowledge of N and H densities is crucial. Finally, through the measurement of the decay rate of Kr(5p)'[3/2]2 versus the Kr density in the gas cell, the quenching coefficient from Kr (kKr) was found to be of 1.73±0.2×10-10 cm3 s-1, in a relatively good agreement with the literature [5], validating the obtained results.

References

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*Intervenant